Wavelet-based prediction of crude oil prices

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Abstract

There are two kinds of transactions in the crude oil markets; one is based on immediate delivery while the other one on future delivery. The spot market is dependent on the first kind of transactions and the future market is associated to the second one. Market condition (e.g. market risk, irrational trading, etc.) along with other factors (e.g. credit risk, insurance risk, seasonal factors and etc.) is often the main cause of uncertainty in the crude oil markets. Therefore, the future markets (leading markets) are built up to provide a cover structure for these uncertainties. Also crude oil future contracts, determine definitive prices in future deadlines to buy or sell according to specific criteria of delivery and payment. On the other hand, future prices reflects the markets expectations about future conditions. Consequently, large differences between futures and spot prices is often used to describe the overall market conditions. Wavelets are used as a legitimate alternative alternative for irregular situations such as data or signals with scaled features, or containing discontinuities and sharp edges and so on (see [1-2]).

In this study, we are going to use the wavelets as a suitable tool to investigate its performance in the crude oil futures markets (see [3]). We intend to provide forecasts over different forecasting horizons by introducing a prediction procedure and predicting future prices based on the wavelets by utilizing a series of data from the crude oil market and at last putting the results in comparison with the crude oil future markets data. **Definitions and Basic preliminaries**

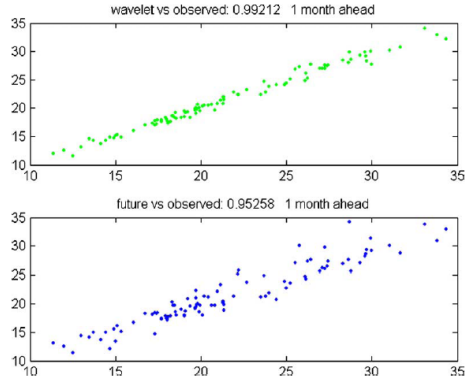
1.Multi-scale analysis

multi-scale analysis with a sequence of involute sub-space V_j of functional space of procedure V with null common point and at dense in $L_2(R)$. This analysis is a discretion at different levels of scalability, which requires two-scale relationship such as $f(x) \in V_j \Longleftrightarrow f(2x) \in V_{j-1}$ (see [4-5]).

2.discrete wavelet transform(DWT)

discrete wavelet transformation enables us to discrete a time based sequence to subsequences with different scales in order to extract important hidden information and unstable features (see [4-5]).

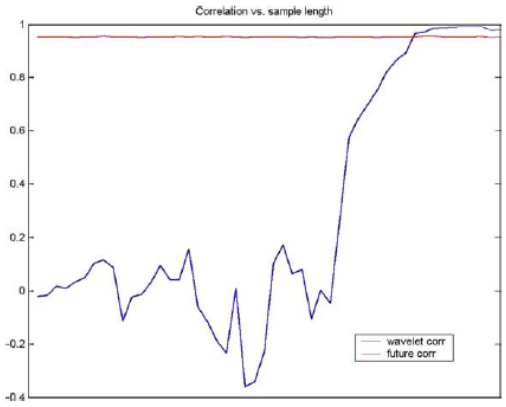
We present a procedure to predict crude oil prices for time series of 1, 2, 3 and 4 month and then compare the predicted values with actual expected prices of future market in mentioned time series and as for 1 month time series the result are shown in below figure:



Forecast results in contrast with observed values

Forecasting horizon	Wavelet-based forecast	Futures
1 month ahead	0.992	0.952
2 months ahead	0.998	0.903
3 months ahead	0.995	0.841
4 months ahead	0.998	0.772

And as you can see in below figure, wavelet based prediction procedure is more efficient for sample with a value bigger than 100 .



Applicable procedure will be created by some main key properties of wavelets and is established based on discrete wavelet transformation (DWT) on Average monthly time series of crude oil. Wavelet based prediction procedure which is used in this study, can be applied to examination of the dynamic properties of various financial and economical phenomenon, like economic time series. also predicted crude oil prices based on wavelets can be used to determine oil prices in future contracts.

References

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